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AUTHOR Duek, JodyLee Estrada; Wilkerson, LuAnn
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ABSTRACT

Of concern in the problem-based learning process in medical student education is the effect of allowing students to generate their own learning issues while discussing cases and problems. This study considered learning issues in problem-based learning, studying faculty and student overlap and consistency across learning groups while adding the perspective of analyzing learning issues developed by students without the assistance of a tutor. Lists of students' learning issues, interviews with the course director and course writer, and final examination scores were collected for 4 of 12 tutorial groups, representing 52 students, and 4 cases prepared by students. The mean case overlap in issues and content covered was somewhat lower for this study than for previous studies using staff tutors. Not having a tutor present during the initial case discussion may slightly reduce the amount of case overlap between faculty-intended learning objectives and the learning issues generated by students for the purposes of self-study. Only one-quarter of the 77 faculty objectives were identified by all 4 groups as learning issues. Results suggest that reliance on a tutorless format may not be appropriate when other sources of structure are absent from the curriculum. (Contains three tables and seven references.) (SLD)

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LEARNING ISSUES IDENTIFIED BY STUDENTS IN TUTORLESS PROBLEM-BASED TUTORIALS

JodyLee Estrada Duek

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Learning Issues Identified by Students in Tutorless Problem-Based Tutorials

JodyLee Estrada Duek
LuAnn Wilkerson
Center for Educational Development and Research
Dean's Office, UCLA School of Medicine
12-138 CHS, 10833 LeConte Ave.
Los Angeles, 90024-6962

Objectives

Of concern in the problem-based learning (PBL) process in medical student education is the effect of allowing students to generate their own learning issues while discussing cases and problems. At UCLA we have used problem-based learning groups without faculty members present when beginning discussion of a new case. What types of learning issues do students generate when left without faculty guidance? How do the student-generated items compare to faculty objectives under these conditions? Is there a relationship between the number of student-generated learning issues and performance on the final examination?

Perspective: Literature Review

There have been few studies of the nature and role of student-generated learning issues in PBL. Most of these studies have examined the overlap between student-generated learning issues and faculty-identified objectives. Coulson and Osborne[1] examined the relationship between faculty objectives for a patient problem and student-identified learning issues. They found that, on average, 5 student groups were sufficient to discover all faculty-identified learning issues. Dolmans, Gijselaers, Schmidt and Van der Meer[2] studied the process of learning issue identification, and distinguished Type A mismatches, a faculty objective not identified by a group, and Type B mismatches, issues identified by a group that were not faculty objectives. They found that the average degree of overlap between faculty objectives and student-identified issues in a small-group session was 64%.

Two additional studies examined student-generated learning issues in relationship to self-study and other curricular features. Dolmans, Schmidt and Gijselaers[3] studied the relationship between student-generated learning issues, faculty objectives and self-directed learning activities. They found that group-identified learning issues were not, apparently, the sole factor influencing self-study. Dolmans and Schmidt[4] then used a questionnaire to discover what course aspects influenced students' learning activities during self-study. They found that the

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importance of group learning issues as a starting point for individual study increases during the four years of medical school. Students' learning activities during self-study are also influenced by the reading material suggested for the course, course objectives (i.e., as stated in the course book) lectures, self-assessment tests in course books, other students, and the tutor.

One study examined the range and consistency of learning issues across multiple groups discussing the same case. Kennedy and Wilkerson[5] had students in problem-based learning groups in an anatomy/ histology course individually list the major issues studied as a result of discussing cases with 3 different types of pathologies. They identified four types of learning issues: structural, functional, clinical and psychosocial. The consistency among groups was highest for gross anatomical issues.

The present study connects these two approaches by considering faculty and student overlap and consistency across groups while adding a new perspective -- an analysis of learning issues developed by students without the assistance of a tutor.

Methods

We used a case study approach[6] to explore the relationship between student-generated learning issues, faculty learning objectives, and examination performance in tutorless problem-based tutorial groups in a gross anatomy course for first-year medical students. The course was part of the first semester of medical school so students had no prior exposure to problem-based learning. Students were randomly assigned to tutorial groups. We selected 4 of the 12 tutorial groups, representing 52 students in the course, as a sample of convenience. The groups met weekly throughout the semester and considered each individual case for two sessions. The initial session, on all except the first case, was conducted by the students without a faculty member (tutor) present, and without a designated student leader. Multiple lectures and gross anatomy dissections were also a part of the course.

Three types of data were collected -- lists of students' learning issues, interviews with the course director and case writer, and final examination scores. During the process of beginning a new case, students listed their self-generated learning issues on large sheets of newsprint. Since no faculty tutors were present during these sessions, these issues represented students' perceived needs for review of prior knowledge, reinforcement of content presented in lectures and laboratories in the same course, or acquisition of new knowledge. The sheets were retained by a group member and used during the second tutorial session for each problem to structure the discussion and to update the faculty tutor on the work done since the first tutorial.

Sufficient documentation was available to study four of the five cases which were begun without a faculty tutor present. Case 2 was a 42-year old male who came to the emergency

room after an episode of chest pain while exercising. Case 3 was a 48 year-old man with liver failure after a long history of alcoholism, who was being considered for transplantation. Case 4 was a 29-year old woman in whom a left adenexal mass was discovered during her fifth week of pregnancy; she feared a serious birth defect in her unborn child. Case 6 was an 18-year old male who nearly drowned during a surfing accident which left him a paraplegic. The newsprint sheets for cases 2, 4, and 6 were available from three groups, and case 4 for all four groups. We initially reviewed the sheets for all cases and groups to determine common themes. Five themes appeared to characterize the issues:

- normal structure and function
- injury and disease states
- diagnostic procedures
- treatments
- psychosocial issues

We then sorted the students' learning issues into these categories.

Next, one of the authors (JLED) interviewed the course director and the case writer. They had selected each case to stimulate study of a particular organ system but had not developed specific learning objectives since they felt that, taken with the accompanying lectures and laboratories, the intended learning objectives would be fairly obvious. During the interviews the course director helped develop a master list of primary and secondary learning objectives for each case. In addition, he reviewed the categorized list of students' learning issues and added objectives to the master list when he felt that students had identified an important issue that he had overlooked.

Third, we identified the final examination scores for the 52 students in the four groups. The examination consisted of multiple choice, extended matching and slide or tissue identification items. A mean examination score was calculated for each group and group means were compared using multiple t-tests.

Results

The course director identified a total of 77 learning objectives for the four cases. Table I illustrates the breakdown of these objectives by priority and theme.

Table I
Number of Faculty Objectives for Each Case by Priority and Theme

Faculty Objectives	Case 2	Case 3	Case 4	Case 6	TOTAL
Total objectives	13	27	20	17	77
Priority					
Primary Issue	9	11	15	12	47
Secondary Issue	4	16	5	5	30
Theme					
Structure/ function	1	3	4	3	11
Injury & disease	5	11	5	4	25
Diagnostics	2	6	6	3	17
Treatment	2	4	2	4	12
Psychosocial	3	3	3	3	12

Table II shows the number and percent of faculty learning objectives identified by students for each case in each group. We have labeled this **case overlap** (issues identified by a group, when groups are considered one at a time).

Table II
Case Overlap:
Number and Percent of Faculty Objectives Identified for Each Case by Each Group

	Case 2 13 objectives		Case 3 27 objectives		Case 4 20 objectives		Case 6 17 objectives		Mean % per group
Group	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
A	5	38	11	41	–	–	9	53	**44**
B	10	77	13	48	12	60	–	–	**62**
C	11	85	15	56	9	45	8	47	**58**
D	–	–	17	63	11	55	6	35	**51**
Mean case overlap		**67**		**52**		**53**		**45**	**Mean of Means: 54%**

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Table III shows the percent of **mean case overlap** (mean percent of identified objectives for a case, averaged across all groups) compared to **potential overlap**, the percent of faculty objectives identified by at least one group (identified by any of the groups, when considered all at once as one large group). It also indicates **Core overlap**, the percent of faculty objectives in each case that were identified by every group studied.

Table III
Mean Case Overlap, Potential Overlap, and Core Overlap:
Percentage of Faculty Objectives Identified by Students for Self-Study
During a Tutorless Problem-Based Learning Discussion

	Case 2	Case 3	Case 4	Case 6	
Type of Overlap	**% of 13 objectives**	**% of 27 objectives**	**% of 20 objectives**	**% of 17 objectives**	**Mean %**
Mean Case Overlap[1]	67	52	53	45	**54**
Potential Overlap[2]	100	81	90	76	**87**
Core Overlap[3]	38	19	25	12	**23**

In this study case overlap ranged from 45% for the surfer case (Case 6) to 67% for the chest pain case (Case 2), resulting in a mean case overlap of 54% for students working without a faculty member (tutor) present. This is somewhat less than the comparable value of 64% found by Dolmans, Gijselaers, Schmidt, and Van der Meer[2] for groups with tutors present.

Overlap can also be considered as the percent of objectives for each case which were identified by at least one group. This form of overlap, which we refer to as potential overlap, is useful in determining if a case is constructed in such a way as to make the objectives readily accessible to students. Viewed in this way, potential overlap ranged from 76% for the surfer case (Case 6) to 100% for the chest pain case (Case 2), as shown in Table III. Students were slightly more likely to identify objectives from the categories of treatment (92%), injury/disease (88%), and diagnostics (88%) than they were for normal structure-function (82%) or psychosocial issues (75%). Ninety percent of the primary objectives and 80% of the secondary objectives were identified by at least one group. Only 11 of the 77 faculty objectives (14%) were not identified by any student group. This compares favorably with Dolmans who found that 15% of faculty objectives were not identified in her study.

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[1] **case overlap**: identified by a group, when groups are considered one at a time.

[2] **potential overlap**: the percent of faculty objectives identified by at least one group (identified by any of the groups, when considered all at once as one large group).

[3] **core overlap** is the percent of faculty objectives in each case that were identified by every group studied.

Finally, overlap can be considered as those faculty objectives identified by all groups (core overlap). Such a measure might be helpful in identifying the core content of a course composed of multiple groups working on the same problems. Core overlap ranged from 12% for the surfer case (Case 6) to 38% for the chest pain case (Case 2). Interestingly, Case 1, in which a faculty tutor was present in each group during both sessions (to introduce the technique) had a core overlap of 53%. One quarter of the 77 faculty objectives were identified by all student groups as learning issues across all four cases considered. This percentage was much higher in Dolmans at 41%.

The mean examination score for each of the four groups ranged from 86 to 89. Multiple t-tests demonstrated no significant difference in scores among the four groups.

Discussion

In problem-based learning, the faculty prepares problems or cases for discussion by multiple small groups. Each case is selected and composed to stimulate the discussion and study of key learning objectives. The degree to which students working in a collaborative small group setting will identify learning issues for self-directed study that correspond to the faculty's objectives can be used to tell us something about the work being done by individual groups, variability among multiple groups as they discuss the same case, the power of a case to stimulate specific learning issues, and the core content covered by every group. Of particular interest in the present study was the lack of a faculty tutor to direct the students' discussion as they developed their learning issues during the initial session on each case.

A view by cases

The concept of case overlap is a useful one for examining the performance of individual cases and of individual groups. If the mean case overlap value is 54%, we might want to look at those cases in which the percentage is much lower; here the surfer case, Case 6. Is there some reason that students might not be identifying learning issues that are concurrent with the faculty objectives in this case? No group identified topics related to cervical function, injury to cervical ligaments, electrolyte imbalance, or psychological problems associated with sudden paraplegia. For example, it is not surprising that students overlooked the electrolyte issue which was slipped into a dependent clause of a single sentence, e.g., "After correction of his electrolyte abnormalities due to near salt-water drowning, and stabilization of his pulmonary function, Mr. Johnson is transferred to Rancho Los Amigos Hospital for surgical stabilization of his cervical fracture."

A view by groups

We can also look at the average case overlap for each group. A consistently low case overlap percentage in any one group might suggest some problem with the way that the group is identifying its learning issues. For example, one of the groups that we studied tended to identify fewer numbers of faculty objectives. The faculty tutor, when asked, indicated that the students were not consistent in writing down their identified learning issues.

A view of the course

Finally, case overlap can be averaged across all cases to tell us something about the course. What percentage of faculty objectives are being identified by students as learning issues? Students in our four tutorless groups identified an average of 54% of the faculty's learning objectives for the four cases examined. Dolmans et al[3] reported an average case overlap of 64% in groups with tutors. The comparison suggests that tutors may be helpful in prompting students to identify learning issues that correspond to the intent of the faculty. It is also possible that the type of case used in the two different schools, and the number of possible faculty objectives developed for each case, play equally important roles in increasing or decreasing the match between students' learning issues and faculty objectives. The mean number of faculty objectives per case was 4.3 in the Dolmans study and 19 in our study. The cases used in the Dolmans study were simple physiologic states in need of explanation. One example given was only one paragraph in length while our cases were complex, data-rich patient cases two to three pages in length.

Potential overlap indicates how well each case serves as a stimulus for the faculty objectives. In the four cases that we studied, 66 of the 77 faculty objectives were identified by one or more student groups. We called this feature **potential overlap**. It suggests that the cases were appropriately structured to raise the intended objectives. We are in the process of examining the 11 objectives that were not identified, in the light of case details, to determine what changes might need to be made in the case presentation or in the objectives themselves. This is particularly important since we cannot rely on faculty tutors (who are not present) to provide guidance. One strategy that we have used is the inclusion of two to three suggested study questions at the end of Part One of each case. In a subsequent observational study of the tutorless groups, we found that some student groups paid little attention to these questions when determining learning issues.

One of the concerns that many faculty members express about the student-directed nature of problem-based learning is the lack of a common curriculum across student groups. This concern seems justified by the results of our study which demonstrated that only one quarter of the 77 faculty objectives were identified by all four groups as learning issues. With a large number of groups participating, however, this core overlap might be more usefully defined as

issues identified by 90%, (or a similar figure) of the groups, since variability among groups as they pursue different sections of a case makes 100% identification difficult when 10 to 15 groups are considered. The chest pain case (Case 2) stimulated the most concurrence with 38% of the faculty objectives identified by all four groups. This case also had the highest case overlap, the highest potential overlap, and the fewest faculty objectives. The high overlap scores could be a reflection of the fact that, of the four cases, the one involving chest pain is a more familiar scenario to anyone who reads widely or encounters medical drama in the popular media. Also the fewer faculty objectives increases the likelihood of student concurrence. Given the lack of difference in the examination scores among the groups, it may be that as Dolmans and Schmidt[4] found, students study topics derived not only from the cases, but from other aspects of the course as well, such as lectures, laboratory exercises, the text, and the course syllabus. This broad study agenda may serve to offset the lack of a larger common core in our problem-based learning curriculum. The mean examination scores of the groups, ranging between 86 and 89, suggests that students are learning a majority of the material in the course even if the small group discussions are not uniform in their coverage of content.

In conclusion, the mean case overlap was somewhat lower in this study than that reported in two previous overlap studies[1,3] using staff tutors. Not having a staff tutor present during initial case discussion may slightly reduce the amount of case overlap between faculty intended learning objectives and the learning issues generated by students for the purposes of self-study. However, it is essential to note that problem-based learning in this course is accompanied by lectures and laboratories from which students can draw additional clues about what topics are essential to study. In a recent study of the relationship between exam performance, tutor expertise, students' prior knowledge, and course structure, Schmidt[7] noted that "students need a minimum level of structure in order to profit from problem-based instruction." He concluded that this structure can be derived by students on the basis of their prior knowledge, the structure of the curriculum, or the expertise of the staff tutor. In our anatomy course, the structure provided by laboratories and lectures may have eliminated the need for faculty tutors. The tutorless format was initiated at UCLA to reduce the demand on faculty time, involving faculty tutors when their expertise is most crucial -- during the return to a case as students teach one another what they have learned during self-study. The reliance on a tutorless tutorial format may not be appropriate when other sources of structure are absent from the curriculum.

Comments on further work

During the Fall semester of the school year 1994-1995 three of the four cases were repeated, with the lowest ranked case on all measures, the surfer case, Case 6, being replaced. The newsprint sheets were collected from a total of 11 groups. The data so far appear quite similar to the present study, providing more robust numbers, and are still being analyzed.

Additionally, one author, (JLED) sat in on the problem-based learning sessions for three of the eleven groups during two cases. Verbatim audiotapes were made and transcribed, and she annotated, with a second recorder, the behavioural aspects of the sessions; seating arrangements, the roles students performed, and the ways they interacted.

Some of the results of these studies include:

- Since the original faculty objectives were stipulated after the cases had been studied by the 1993-1994 students, the present study focused on Dolmans et al[2] Type A mismatches: a faculty objective not identified by a group. Dolmans Type B mismatches: issues identified by a group that were not faculty objectives, were virtually nonexistent since the student lists of learning issues were used to assist in reviewing and adding to the initial faculty objectives. The 1994-1995 data include a number of Type B mismatches which are being inspected and categorized.
- A decision has been made to post the faculty's suggested objectives after the second session of each case, to allow groups to measure their success at achieving faculty goals and reevaluate their methods. The continuing feedback in both directions will allow for further refinement of the case as well as of student skills.
- Discussion is now occurring regarding the installation of one or more sessions at the beginning of the school year to train student participants in the more metacognitive, process-oriented aspects of group work, to heighten their awareness of group function, to improve communications, and to strengthen their ability both to work cooperatively and to keep the problem-based learning goals in mind.

More work needs to be done looking at the ways students interact in the groups, particularly with regard to the teaching of the learning issues to each other. Even if a group has correctly identified all faculty objectives and individually learned their separate issues, if they are unable to share the information in an appropriate manner to assist other group members some of the purposes of problem-based learning are being subverted. Some of this could also be addressed by point 3, above, training students in the praxis of group process.

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